Saskatchewan Agriculture, Food and Rural Revitalization

FARM Facts

Fertilizing Tame Pastures

Introduction

Tame forage pastures can be highly productive, but this productivity gradually declines as the stand ages. Research has indicated that fertilization can bring the productivity of the stand back to its original level. However, the added carrying capacity does not always cover the associated costs. The profitability of fertilizing tame pastures is variable and depends on the cost of the fertilizer and livestock prices. As these factors change so will the feasibility of fertilizing. Pasture fertilization must compete economically with alternative sources of additional grazing such as community pastures, rental or purchase of new land, and inclusion of alfalfa in the grass seeding.

This fact sheet provides general information on fertilizing tame pasture in Saskatchewan, primarily focusing on the Parklands where moisture conditions are most favourable. A worksheet is also provided to illustrate the costs and benefits from fertilizing pasture for cow-calf and stocker operations.

Production

Fertilizing pastures can significantly increase yields in the Parklands and adjacent areas of Saskatchewan. On a moist dark brown soil at Scott, annual applications of 50 kg nitrogen/ha, plus periodic phosphate applications, more than doubled yields of smooth bromegrass stands (Table 1). Annual applications of 100 kg nitrogen/ha, plus periodic phosphate, more than tripled yields. The yields were slightly more than double that of unfertilized bromegrass, at 100 kg nitrogen/ha without phosphate. On grey-wooded soil at Pathlow, fertilizing with 90 kg nitrogen/ha, 45 kg phosphate/ha, and 10 kg sulphur/ha every second year, increased yields 2.7 times that of unfertilized pasture in the year of application and 1.5 times that of unfertilized pasture in the year after application (Table 1).

With the above fertilization rates applied every second year, the fertilized pasture at Pathlow had about 70 per cent more grazing capacity than the unfertilized pasture because of greater stocking levels and a longer grazing season. Weight gains of the cows were also improved on the fertilized pasture.

Fertilization trials in the southwest have indicated yield responses are generally lower and more variable. In all areas of the province, there is a strong relationship between fertilization response and precipitation. Although the yield response is often lower in dry years, there still is an increase in yield due to fertilizing. Extra growth in dry years is even more important than in wet years.

Plants begin using the fertilizer early in spring, when moisture and temperature are typically favourable for growth. The resulting flush of spring growth cannot be taken away once it has been produced, even if the balance of spring and summer are dry. Lastly, in drier areas or drought prone soils, fertilizing will produce lower yield responses, and the yield response is more variable from year to year.

TABLE 1 Examples of yield response to fertilization at various locations in Saskatchewan

Location Soil Zone	Forage	Fertilizer Rate (kg/ha)	Yield (kg/ha)	
			Unfertilized	Fertilized
Swift Current Scott Brown	Various Grasses	50 N	780	1170
Dark Brown	Bromegrass	50 N[1]	960	2400
		100 N[1]	960	3340
Loon Lake Grey Wooded	Bromegrass	100 N	1000	2100
		50 N[2]	1220	2370
		100 N[2]	1220	2950
Pathlow Grey Wooded	Brome/ Bluegrass/ Alfalfa	45 N + 45 P	1640	3200
		90 N + 45 P + 10 S	1090	2900
		response in 2nd yr	1090	1590
Indian Head Black	Bromegrass	55 N + 12 P	1570	3160
		110 N + 24 P	1570	4180

N - Nitrogen P - Phosphorus S - Sulphur

[1] Phosphorus was also applied at 100 kg/ha about every third year.

[2] Phosphorus was also applied at 224 kg/ha every second year.

Protein Content

Nitrogen fertilization increases the protein content of grasses. The improvement in protein levels is most pronounced in the vegetative stage and declines as plants mature. By early July, the increase in grass protein levels is down to one or two per cent. Consequently, fertilizing for increased protein alone is not economical. Total yields of protein, however, will be higher in fertilized stands because of greater dry matter production.

What Nutrient to Use

Nitrogen and phosphorus are two of the more important nutrients needed in Saskatchewan soils. In grass-legume pastures, nitrogen fertilization favours the grasses, while phosphorus favours the legumes. To reduce the long-term need for nitrogen fertilizer, it is important to manage mixed stands to maintain the legumes as long as possible. If the legume roots contain active nodules, the legumes will fix much of their required nitrogen through symbiotic nitrogen fixation. To maintain the legumes in these mixtures, higher phosphorus and lower nitrogen fertilizer levels are the most beneficial. As a rule of thumb, stands with 80 per cent or more grass should be fertilized as a pure grass stand. When the alfalfa is 30 per cent of the stand or more, the intent of the fertilizer program should be to favour the alfalfa.

Liquid and dry forms of nitrogen fertilizer both significantly increase pasture production, provided precautions are taken at the time of application. Ammonium nitrate (34-0-0), because of the reduced risk of volatilization, is the most efficient form of nitrogen for broadcast application.

Urea is the most widely used source of fertilizer nitrogen. It has a high nitrogen content and low cost per unit of nitrogen. If urea is broadcast, some of the nitrogen may be lost by volatilization. Losses will be greatest when the soil surface is dry and the urea is applied during warm, dry weather. Since urea supplies more than half the nitrogen in liquid nitrogen fertilizers, similar care should be used with their application.

Mono-ammonium phosphate (11-55-0) is the most common form of fertilizer phosphorus. Liquid phosphorus fertilizers are also available and effective.

Potassium and sulphur can also affect forage quantity and quality, especially of legumes. Most soils of Saskatchewan contain adequate amounts of these nutrients. However, some coarse textured soils, grey wooded soils and peat soils may be deficient in these nutrients. Soil tests are useful in determining which nutrients are lacking and what rates of fertilizer should be used.

Fertilizing with Manure

Animal manure is a useful source of plant nutrients as well as an excellent soil amendment (Table 2). Not all nutrients in manure are immediately available to plants. Research indicates that yield responses of manure-treated alfalfa and grass-alfalfa stands approach the yields obtained with similar rates of nitrogen and phosphorus applied with commercial fertilizers. Manure application must be timed to minimize problems with fouling of the forage. Manure should not be applied to frozen ground.

Nitrogen Fixation by Alfalfa

One other form of fertilizer is simply the inclusion of alfalfa or other legumes in the pasture seeding. Properly inoculated alfalfa seed will supply nitrogen to both the alfalfa and its companion grass, which significantly improves the production of the pasture. In terms of cost-effectiveness, no other measure can match the value of including inoculated alfalfa in the pasture seeding.

When to Fertilize

Early spring application is generally the most effective because conditions that can result in losses due to volatilization, leaching and runoff are relatively low. Applying the fertilizer just prior to the onset of spring growth allows the plants to make effective use of it. Spring fertilization should occur as soon as the field permits equipment travel. Late fall applications are also effective and may be more practical where road bans, time constraints, or wet soils may delay application in early spring.

Fertilizer Methods

Nitrogen, phosphorus and other nutrients can be broadcast, injected, or knifed into existing stands. Broadcasting is the most common method of application to existing stands. Phosphorus is relatively immobile in the soil. Banding fertilizer into existing stands provides better phosphorus utilization but adds to the cost and can damage stands if the application machine is not low disturbance. Up to 15 lb. ac of phosphorus can safely be applied with the seed with most seeders. Broadcasting and incorporating phosphorus prior to seeding is another effective option where pre-seeding tillage is used.

Split applications of nitrogen have given variable results. Splitting annual applications of nitrogen fertilizer instead of a single spring application should be used only in high moisture areas or under irrigation. Split applications of less than 50 kg nitogen/ha (i.e. two 25 kg/ha applications) are not recommended.

TABLE 2 Nutrient Content of Solid Fresh Manures

Animal Source	Total Nutrient Content kg/tonne (lb/ton)		
	Nitrogen (N)	Phosphate (P_2O_5)	Potassium (K_2O)
Cattle	6 (12)	3 (6)	6 (12)
Swine	5 (10)	4 (7)	5 (9)
Poultry	15 (31)	9 (18)	5 (9

Source: Guide to Farm Practice

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Efficient Use of Fertilizer Dollars

For fertilization to be economical, the increased forage production must be efficiently used by the livestock. Since the amount of additional forage is related to soil moisture conditions, it is difficult to predict the expected increase in grazing capacity. Fertilizing all pastures concurrently is expensive and is inefficient, unless it is possible to annually or seasonally vary the number of animals to match the varying production.

Grazing with feeder cattle can give flexibility, if the length of grazing season or number of animals can be reduced in years of poor growing conditions. With cow-calf operations, it is more difficult to reduce the herd during the grazing season or to shorten the grazing season to match annual fluctuations in forage production. As a result, fertilizer dollars may be optimized through a number of alternatives. One option is to fertilize a portion of the total pasture acres each year, such as one pasture out of four. Fertilizing the spring pasture may allow for grazing one to two weeks earlier than would otherwise be recommended.

Pastures in good to excellent condition generally respond to fertilizer better than pastures with weeds or less productive grasses. Similarly, soil type can affect the response of a pasture to fertilization. Coarse sands and gravelly soils will generally give a lower yield response to fertilizer than finer sandy soils, loams or clays.

When fertilizing tame forages, it is important to use sound controlled grazing practices. Controlled grazing does not require extensive fencing and water development. Providing four or five pastures of similar carrying capacities will help distribute livestock grazing and make the most of the fertilizer dollars.

Fertilize fewer acres with higher rates (50-90 kg nitrogen/ha) rather than more acres at lower rates (30-40 kg nitogen/ha). Fertilizing at rates of 200 kg nitogen/ha or higher can lead to toxic concentrations of nitrates in forage. Soil tests in late fall or early spring will identify nutrient deficiencies and allow informed decisions on the amount of fertilizer to be added.

Costs and Benefits of Fertilizing

A number of factors influence the economics of fertilizing pasture. The major costs associated with fertilizing a pasture include the costs of the fertilizer and its application. Additional costs include: storage, transport, and interest for the fertilizer once it has been purchased. The benefit of fertilization is often only identified as an increase in forage production. If this production does not return the cost of the fertilizer, then it is considered uneconomical. However, there are other benefits from fertilizing that are not measurable through added production alone.

Fertilization and proper grazing management extend the productive lifespan of a pasture. This reduces the need for rejuvenation. The saving on rejuvenation will offset a portion of the annual fertilizer costs. Through a balanced long-term fertilizer program, more cattle can graze on the existing land base. This helps save seeding, fencing and water site costs, if new land is required to meet this additional demand; or taxes and interest charges, if additional pasture is purchased. As a result, producers are less dependent on rented pasture and the uncertainty of long-term tenure and rental charges.

Trucking costs and additional labour costs must also be considered if cattle are hauled to rented or deeded pasture. Given these factors, it may sometimes be economical to fertilize rather than rent additional pasture even though fertilizing may not be the lowest cost alternative.

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Fertilization Worksheet

Assumptions:

1. Fertilizer costs:

50 lb. nitrogen/acre at $0.34/lb.	= $17/acre
20 lb. phosphorus/acre at $0.40/lb.	= $8/acre
Application cost	= $2/acre
Total	**= $27/acre**

2. Cow/calf operation: 1300-lb.cow with calf (1.3 animal units (AU) equivalent). The cow would need eight unfertilized acres of grazing for five months. The calf gains at a rate of 2.5 lb./day.
3. Grasser operation (grazing yearling calves to feedlot weight): 800 lb. average weight (0.8 AU equivalent). The yearling would need four unfertilized acres of grazing for four months. Average daily gain = 1.8 lb./day.
4. Pasture is currently seven years old and about half its original production. Yield responses to the above rates of fertilizer are based on information from Table 1 for the moist dark brown, black, and grey-wooded soil zones and from the grazing and fertility study conducted at Pathlow.

Results

Cow/calf Operation

Applying 50 lb. nitrogen/acre plus 20 lb. phosphorus/acre produces a total of 0.8 AUM (animal unit month) additional grazing. For 1300-lb. cows, this yield response represents 19 additional grazing days per acre.

$$\frac{0.8\ \text{AUM}}{1.3\ \text{AU equivalent}} = 0.62\ \text{months} = \textbf{19 additional days}$$

With a calf gaining 2.5 lb. per day, the return in terms of additional calf growth is $35.63/acre

19 days x 2.5 lb./day = 47.5 lb. x $0.75/lb = **$35.63**

NET RETURN

net return = value of additional gain - cost of fertilizer and application

$35.63 - $27.00 = **$8.63/acre**

Cost per day of grazing = $27.00/19 days = **$1.42/day**

The net return from fertilizing pasture in the above scenario lead to a small profit. However, renting or purchasing new land or grazing in a community pasture would likely be less costly than fertilizing under the above scenario.

Grasser Operation

Applying 50 lb. nitrogen/acre plus 20 lb. phosphorus/acre produces a total of 0.8 AUM (animal unit month) additional grazing. For 700-lb. grassers this improved productivity would provide 30 additional grazing days per acre.

$$\frac{0.8\ \text{AUM}}{0.8\ \text{AU equivalent}} = 1\ \text{month} = \textbf{30 additional days}$$

With a yearling gaining 1.8 lb. per day, the value of this additional grazing amounts to $38/acre.

30 days x 1.8 lb./day = 54 lb. x $0.70/lb = **$38**

NET RETURN

net return = value of additional gain - cost of fertilizer and application

$38 - $27 = **$11/acre**

Cost per day of grazing = $27 / 30 days = **$0.90/day**

The net return and cost per day from fertilizing tame pastures for grassers is more favourable than with cow-calf pairs. However, the cost per day of grazing is high relative to other alternatives such as pasture rental, purchase or community pasture.

The above examples represent only two possibilities. The multitude of variables encountered in the field of agriculture could produce different impacts on the economics of fertilizing. Fertilizing at heavy rates on one-half of the paddocks each year could lower costs as opposed to the above examples. Some producers working with intensive grazing rotations use fertilization as one tool for increasing their carrying capacities. Since the cost of fertilizing is spread over a greater number of animals in these situations, the cost/head/day is also lower.

For more information, contact the nearest Rangeland and Forage Agrologist.

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